## REMARKS

Claims 1-27 are pending. Claim 23 has been amended. A new drawing sheet having FIG. 11 is enclosed. Reconsideration is requested.

Rejection on Prior Art

All of the pending claims have been rejected on Russell (4,071,017), Lechner (5,365,920) and/or Kelton (4,296,738).

**Description of Russell solar collector**

U.S. Patent No. 4,071,017 to Russell is an extension of prior art also by Russell. In the prior art, U.S. Patent No. 3,868,823, Russell discloses a Fixed-Mirror-Solar-Concentrator or FMSC.

In an FMSC the mirror is fixed and the receiver moves to remain at the concentration focus as the sun traverses the sky. The mirror used in the FMSC is described as a plurality of long, narrow, flat reflecting surfaces arranged along a reference cylinder and angled so that they focus to a location that is twice the radius of the reference cylinder. To arrange the mirror facets on the reference circle the reflective surface is made discontinuous by elevation steps required between adjacent mirrors. The system has a receiver mounted on an arm with a length equal to the reference cylinder radius that is mounted and pivots at the center of the reference cylinder. This geometry allows the receiver to be rotated on its mounting arm to stay at

## AMENDMENTS TO THE DRAWINGS

A new sheet of drawings including FIGs. 9-13 is attached. The contrast between light and dark has been increased to more clearly show the content of FIG. 11.

the focus of the fixed mirror while the sun traverses the sky. The receiver is described with a variation that includes a secondary mirror. The secondary mirror is due to an inherent inability of a Russell's FMSC system to generate concentration levels on par with other mirror systems. The concentration deficiency is due to: 1) the use of flat faceted mirror elements and 2) the large distance required between the mirror and focal point so that a simple pivoting arm can position the receiver at the focus.

In Patent No. 3,868,823 it is indicated that earth moving equipment could be adapted to carve out the necessary shape for a mirror consisting of "earth embedded reflecting surfaces". The idea was that the ground could be shaped and then stabilized with asphalt. The asphalt would be contoured in a manner that provided precisely angled steps. Mirrors would be fixed to each step creating the mirror elements.

In Patent No. 4,071,017, Russell notes that conventional construction methods cited in Patent No. 3,868,823 probably will not be able to form an "earth embedded reflecting surfaces" with the required accuracy. Russell's Patent No. 4,071,017 describes an FMSC mirror with an improved "earth embedded" construction. In the improved construction, Russell eliminates the concept of fixing the mirrors directly to the stabilized ground along the entire length of the mirror. Instead, Russell proposes to have multiple localized connections to the ground. These localized connections would anchor and guide many pairs of tensioned cables. Each pair of cables would support and orient a mirror element without continuous contact with the ground. Russell elaborates that the cable supported mirror elements can be rigid glass, reflective plastic film tensioned between a cable pair or reflective plastic film weaved through

and tensioned by the cables. In all instances, independent flat reflective elements are created and combined to make a faceted FMSC mirror.

**Description of Lechner solar collector**

U.S. Patent No. 5,365,920 to Lechner shows several embodiments of an inflated cylindrical or constant radius mirror. It is a fact of nature that a pressurized rectangular thin film fixed on two opposing edges will take a constant radius shape. If the thin film is tubular in shape, it will become a cylinder with constant radius sections upon inflation. Lechner applies a reflective coating to a portion of the inflated thin film to create a constant radius mirror. A constant radius mirror does not reflect direct light to a single focus in the manner that a parabolic mirror does. As a result, Lechner proposes two solutions. The first is to add a secondary concentrating mirror. The second is to limit the cylindrical mirror to a 60 degree arc segment.

The embodiment which is cited by the Examiner consists of an inflated thin film cylinder. The "top" of the cylinder is transparent. A portion of the "bottom" of the cylinder is reflective. The cylinder is closed at each end in a manner "known to any person skilled in the art". The cylinder is mounted on pillow block bearings to allow for rotation. A heat exchanger (receiver) passes through one end of the cylinder and out the other. It is either connected to a heat recovery system or an angled leg which allows for adjustment. Lastly a secondary mirror is included and partially surrounds the receiver. The secondary mirror is mounted such that it will maintain position relative to the primary mirror.

Importantly, pressure acting on the tubular thin film is used only to support the film and to persuade the reflective portion of the thin film to take the shape of a constant cylindrical radius mirror.

**Description of Kelton solar collector**

U.S. Patent No. 4,296,738 to Kelton shows a solar collector used to increase a fluid temperature. Kelton describes several features which are claimed to be efficiency improvements. Included in the system is a transparent tubular enclosure which is sealed to endplates by a clamp ring assembly. The sealed enclosure provides a layer of air insulation from exterior ambient air to conserve the energy of the heated fluid.

The clamp ring assembly is described as having an inwardly contoured surface to cooperatively engage the endplate and tube.

Claims 18 and 20 were rejected under 35 USC 102(b). This rejection is respectfully traversed.

The Hochberg mirror is a continuous parabolic trough mirror formed by a reflective plastic film that is guided by tensioned strings. The key features of this design are 1) the continuous parabolic mirror shape and 2) the lack of transverse and axial tension in the film which makes generating the parabolic shape possible.

Hochberg's parabolic trough shape has the advantage of being able to approach the theoretical concentration limit of 100X of sunlight off any portion of the mirror. In contrast, Russell's continuous film embodiment has the film transversely tensioned and weaved between axially tensioned members to create independent flat reflective facets which, individually have concentrations of only 0.33X. Russell's reflective film must be transversely tensioned to remain flat or the reflective surface will achieve even less concentration. Another key difference between Russell's and Hochberg's mirrors is continuity. Hochberg's mirror is continuous which eliminates shaded portions and thus attains 100% surface usage. In comparison, Russell's FMSC mirror is discontinuous with steps between each flat mirror facet. These steps will cause shadowing of each mirror segment during most times of the day reducing surface usage to less than 100%. Light reflected from the steps will not get to the receiver.

As an individual familiar with the art of solar concentrator mirrors, Russell was aware of the performance deficiencies of his FMSC mirror. He pursued his FMSC design because he was convinced that a continuous or discontinuous parabolic trough mirror could not be fabricated on a commercially viable basis. As such, Russell's focus was to avoid expensive mirror elements and support structure. In 3,868,823 Russell specifically states that efforts to use continuous or segmented parabolic mirrors have failed to attain commercialization because the embodiments are too costly to produce. As a result, Russell pursues a mirror consisting of flat independent facets. In addition, Russell states that segmented parabolic mirrors, which move to track the sun are all the more cost prohibitive due to the need for multiple coordinated mount motions. Hochberg's mirror being continuous extremely light weight and self supported by the enclosure will readily track the sun with a single mount motion.

In conclusion, the Hochberg mirror system is clearly unique having attained a high concentrating continuous parabolic trough mirror that is low cost and lightweight. A fundamental mirror characteristic, which separates Hochberg from Russell, is the avoidance of transverse tension in the reflective thin film so that facets are avoided and a continuous parabolic shape is formed. In contrast, Russell's thin film embodiment requires transverse tension to flatten the film to attain any solar concentration.

Claims 19, 21-25, and 1-17 have been rejected under 35 UAC 103(a) as being allegedly unpatentable over Russell in view of Lechner. This rejection is respectfully traversed as well.

The mirror embodied by Russell is a Fixed-Mirror-Solar-Concentrator or FMSC that is built into the earth. The earth foundations provide anchors and guides for the tensioned cables. Russell elaborates that a key to making a commercially successful solar concentrator is eliminating bulky and complex support structures. Basic to Russell's effort to simplify his design is the use of earth foundations for anchors and guides which eliminate the need for bulky and costly structures. This is a fundamental characteristic of Russell's FMSC embodiment. It would be impossible for a pressurized thin film enclosure to surround the mirror without cutting through the earth mounted cable anchors and guides. To understand this more fully it must be realized that a tubular enclosure must be sealed and allowed to expand at its intersection with the earth mounted cable anchors and guides when pressurized. If the enclosure is not allowed to expand at the cable anchors and guides, then loads which are desired for tensioning the cables are lost to the earth mounted cable anchors and guides negating the reason for adding the pressurized tubular enclosure. Considering the added

complexities of sealing and allowing expansion, it should be apparent that the addition of a pressurized tubular enclosure to Russell's simple earth mounting system, would require a completely new cable support and guide structure which would fully negate much of the low cost embodiment at the heart of Russell's design. As a result, it is deemed counterproductive to incorporate Lechner's pressurized thin film enclosure into Russell's FMSC mirror design.

Ignoring the counterproductive nature of separating Russell's FMSC from its earth anchors, there are other inherent characteristics of the design that make using a pressurized tubular enclosure to carry a portion of the mirror cable loads impractical. These are elaborated upon in the following paragraphs.

Russell's FMSC has the cable supported mirror and the moveable receiver located on a reference circle. If the FMSC were placed inside a pressurized film enclosure that was slightly larger than the reference circle, the tensioned cables would be located very near the perimeter of the pressurized tube. For this arrangement the force which can be extracted from the pressurized endplates is proportional to the percentage of perimeter interacting with the cables.

For optical reasons, the cables will not extend beyond 33% of the perimeter. As a result, the axial load available to the cables is reduced to 33% of that available to Hochberg. The size and thus cost competitiveness of a tension member supported mirror is directly proportional to the amount of cable tension. High cable tension allows a long mirror with few guides. A low cable tension requires more costly guides for the same mirror length. A complicated linkage system, which would have to run the entire

length of the collector, could be added to an enclosed Russell concentrator to connect the cables to the full perimeter or center of the endplates, however, this would also be costly and thus counterproductive.

A method of overcoming the reduction in cable tension capability would be to increase the size of the pressurized tube. The pressurized enclosure could be increased in diameter so that the tensioned cables of Russell could be located on the center of the endplates as they are in Hochberg. This configuration allows the cables to maximize the amount of load extracted from the endplate. The disadvantage for Russell's FMSC in this configuration is that for the same mirror the pressurized tube must be 35% larger in diameter than that used in Hochberg. This is because Russell's FMSC requires a receiver that is located above the mirror on the reference circle of the mirror. Hochberg's receiver can be set at a wide range of heights above the mirror. As a result, the size of Hochberg's pressurized tube is set by the mirror width as opposed to the receiver height. Russell, having a larger pressurized tube raises the height of the collector and requires more support structure. In addition, the material for the pressurized tube constitutes 30% of the overall cost of Hochberg's system. Russell's system requiring a proportionally larger enclosure will be even more costly and thus counterproductive.

In conclusion, a fundamental feature of Russell's FMSC system is the replacement of bulky and expensive mirror support structures with simple earth anchored and guided tensioned cables. Attempting to relieve a portion of the cable load from the earth anchors with a pressurized tubular enclosure is counterproductive for cost, complexity and lack of need. No one skilled in the art of solar concentrators

would add a pressurized tubular enclosure for relieving cable tension from the earth anchors because it is counterproductive. Moreover, it is a combination not suggested by the art and therefore entirely based upon hindsight gained from Hochberg's application.

Claims 26 and 27 stand rejected under 35 USC 103(a) as being allegedly unpatentable over Lechner in view of Kelton. This rejection is respectfully traversed.

It is noted that Lechner contains a pressurized tubular housing which is sealed by endplates. Lechner does not describe endplate features such as the convolution edges and clamp ring which seal the thin film to the endplate in Hochberg.

It is also noted that Kelton has a solar collector with a tubular housing that is sealed to endplates by ring clamp assemblies that include inwardly contoured surfaces.

Being in the same field, the Examiner has concluded that a person of ordinary skill in the art could have modified Lechner with the ring clamp assemblies from Kelton that include inwardly contoured surfaces to achieve the claims of Hochberg.

Kelton's ring clamp assemblies have constant radius continuous grooves on their inner diameter surface that can be described as inwardly contoured surfaces. These grooves are engaged by constant radius continuous flange features on the tubular housing and endplate. These grooves are used to axially position the endplate relative to the tubular housing and do not provide any benefits for sealing or assembling a thin film joint. In contrast, Hochberg's endplate and claim ring assembly

have convoluted edges where the edge radius varies in accordance to a sine function. This innovation provides a clear advantage in the sealing of a thin film tubular joint. As the film is compressed into the convolutions by the clamp ring, it is deterministically stretched to generate a perfectly smooth surface which allows an air tight seal. Another benefit of Hochberg's design is that the perimeter of the convoluted edge is larger than the perimeter of a circle that intersects the peaks of the convolutions. As a result, the thin film tubular enclosure diameter can be sized to be larger than the endplate maximum diameter, thus, providing an advantage during assembly.

In conclusion, Kelton's clamp ring assemblies have simple constant radius features used to axially position components. These compare in no way to the convoluted edges of Hochberg which uniquely provide assembly and sealing advantages for a thin film joint.

Based upon the foregoing, pending claims 1-27 appear to be readily distinguishable over the cited art and therefore patentable thereover. Accordingly, an allowance of claims 1-27 is earnestly solicited.

Respectfully submitted,

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